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Study AFS 43

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

MENDENHALL ANADROMOUS FISH REARING PONDS

by

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TABLE OF CONTENTS (Continued)

Section N

Study AFS 43
Mendenhall Anadromous Fish
Rearing Ponds

Page No.

Job No. AFS 43-5
Pond Rearing of Chinook and Coho Salmon

Michael R. Bethers

Abstract	1
Background	2
Recommendations	3
Objectives	5
Techniques Used	5
Findings	9
1973 Brood Coho, Mendenhall/Blind Slough Stock	9
Rearing	9
Release	9
Return	9
1974 Brood Coho, Mendenhall/Blind Slough Stock	12
Rearing	12
Release	19
Return	19
1975 Brood Coho, Mendenhall Stock	19
Rearing	19
King Salmon Production, 1972 Brood, Carson River, Washington Stock	21
Rearing	21
Release	21
Return	21
Discussion	23
1973 Brood Stock	23
1974 Brood Stock	29
1975 Brood Stock	29
Literature Cited	32

RESEARCH PROJECT SEGMENT

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Job No.: AFS 43-5 Job Title: Pond Rearing of King and Coho Salmon

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ABSTRACT

In 1976, experiments conducted at the Mendenhall Lakes rearing facility were designed to, (1) compare survival and growth of freshwater pond-reared and pen-reared coho salmon, Oncorhynchus kisutch (Walbaum), (2) to compare return rates of pond-reared and hatchery-reared coho smolts imprinted to the Mendenhall facility, (3) to provide an experimental lot of coho salmon for overwintering in saltwater rearing pens, and (4) to evaluate returns of pond-reared and hatchery-reared coho and king salmon, Oncorhynchus tshawytscha (Walbaum), previously released from the facility.

Survival of pen-reared coho was higher than that of pond-reared coho. The average size of surviving pond-reared coho was larger than that of surviving pen-reared coho. Fry to smolt survival from planting to removal of coho was 38,694 (27.7%) in Moose Lake, 4,233 (42.3%) in a rearing pen stocked with 10,000 fry, and 2,470 (49.4%) in a rearing pen stocked with 5,000 fry. The weights of smolt removed from Moose Lake averaged 52.9/kg (24/lb), those from the pond stocked with 10,000 fry averaged 70.6/kg (32/lb), and those from the pond stocked with 5,000 fry averaged 90.4/kg (41/lb).

Moose Lake was restocked on June 7, 1976 with 545,000, 1975 brood coho fry averaging 992/kg (450/lb). On September 16, 17, and 18, a total of 99,439 of these coho averaging 66/kg (30/lb) were transferred from Moose Lake to Fish Creek saltwater rearing facility for overwintering.

Of 100,583 coho smolts released from the facility in 1975, an estimated 89 adult coho were taken by Juneau area sport fishermen, 1,064 by commercial trollers and 3,501 adults returned to the facility in 1976.

Of 217,436 spring king smolts released from the facility in 1974, an estimated 40 fish were taken by Juneau area sport fishermen in 1976, and 184 returned to the facility. Total return rates of the age 1.2 king salmon were 158/93,129 or 1.7% for pond-reared smolts and 66/124,309 or 0.05% for hatchery-reared smolts imprinted to the Mendenhall facility. The coho jack return from 93,538, 1974 brood smolts released from the facility in spring 1976 was 728 fish (0.8%).

A total of 1,008,000 coho and 225,000 king salmon eggs were taken in 1976 for future use at artificial rearing facilities.

BACKGROUND

A declining catch per unit of fishing effort in the Juneau area salmon sport fishery prompted the Sport Fish Division to study the feasibility of providing additional salmon for the fishery by pond-rearing salmon to smolt stage in existing lakes in the Mendenhall Valley north of Juneau. The project was first envisioned in 1968. The potential rearing lakes were situated on Forest Service land, so a cooperative agreement between the Department of Fish and Game and the U.S.Forest Service was written and the Mendenhall Salmon Rearing facility was begun. Both agencies participated in the original planning and engineering of the facility. These plans called for the pond-rearing of king, Oncorhynchus tshawytscha (Walbaum), and coho, O. kisutch (Walbaum), fry to the smolt stage in three lakes.

Capital improvement construction began in 1972 and included dredging of one lake, constructing a holding pond, and dredging channels linking the lakes to a common outlet. Several dikes, concrete control structures, and two roads were also constructed. Salmon fry were first planted in Norton, Dredge and Moose lakes in 1973.

During the first year of operation, engineering problems were encountered which precluded further use of Dredge and Norton lakes for rearing. The outlet control structure and dikes at Dredge Lake were inadequate and frequent washouts allowed rearing fish to escape. For further use as a rearing lake, the inlet and outlet dikes and control structures would require replacement and the lake would have to be sculptured to facilitate seining. At Norton Lake there was insufficient flow from the outlet to attract salmon smolts and the lake was unsuitable for seining. Further use of Norton Lake would require sculpturing and modification of the outlet channel. The flow from Moose Lake, where the original outlet structure was situated, was also inadequate to attract salmon smolts. However, access around the lake was good and the lake could be easily seined after lowering the water level by pumping. It was decided to reduce the scope of the rearing facility and to determine its usefulness through the rearing of fish in Moose Lake only. If the project was determined to be useful and monies were available, then Norton and Dredge lakes could be put into production.

During the first year of fish rearing operations (1973), effort was directed toward determining the feasibility of producing salmon smolts by pond-rearing methods in Norton, Dredge and Moose lakes (Bethers, 1974). Considerable manpower was expended the first year maintaining poorly engineered facilities and little biology was conducted. However, in spring 1974 a total of 81,425 coho smolts were released from Norton and Dredge lakes, and 93,129 king salmon smolts were released from Moose Lake. Smolts were produced from 45.5% of the fry planted in Norton Lake and 60.9% of the fry planted in Moose Lake. Dredge Lake could not be evaluated because of unknown fish losses during washouts (Bethers, 1975).

Moose Lake was restocked with rearing coho on September 16, 1974. These fish were of two different sizes, 109,500 at 83/kg (183/lb) and 99,985 at 36.3/kg (80/lb) and averaged 57.6/kg (127/lb) after two days mixing in the lake. In May 1975 only 10,167 coho were found surviving in Moose Lake. The low survival could have been due to, (1) rapid changes in water temperature, (2) predation by common mergansers or, (3) the small size 83/kg (183/lb) of fish planted in Moose Lake (Bethers, 1976).

During 1975 studies were designed to compare growth and survival of coho reared in Moose Lake with coho reared in fresh water pens and to compare adult returns from pond reared smolts with returns from hatchery reared smolts imprinted to the Mendenhall facility (Bethers, 1976). It was determined that fish growth in Moose Lake was greater than growth of fish reared in pens. However, total survival was greater in pens than in Moose Lake.

The overwintering capability of Moose Lake has not been determined. It is believed to be a factor that could prevent the Mendenhall facility from becoming a "production" facility. By 1976 it was suggested that Moose Lake could best be used for freshwater rearing of coho fry destined for the Fish Creek saltwater rearing facility. By using Moose Lake as a freshwater "prepping" station for fish destined for the saltwater facility, it is believed that the maximum number of locally reared coho smolts could be released for the fisheries. In 1976, 545,000 coho fry were planted in Moose Lake, with plans to transfer the fish to the saltwater facility for overwintering. Results of this study will be presented in later reports.

Some of the marked coho released from the Mendenhall facility were recovered in the commercial and sport fisheries in 1975 and 1976. Data collected in 1975 showed an estimated 333 coho from the Mendenhall facility taken by Juneau area sport fishermen and 901 by commercial trollers. In 1976 an estimated 89 coho were taken by Juneau sport fishermen and 1,064 by commercial trollers. Tag recoveries indicate that most commercial recoveries are made in the "outside" and Icy Straits troll fisheries. Creel census indicates that coho returning to the Mendenhall facility enter the Juneau area in late August and miss the peak of sport fishing activity; hence, the low utilization of artificially produced coho by the Juneau area sport fishermen.

RECOMMENDATIONS

1. The facility should develop a brood stock of coho that will return to the Juneau area at an earlier date than the present Mendenhall stock. The present Mendenhall stock of adult coho enter the Juneau area fishery in September and ascend the Mendenhall River in October. It does not contribute substantially to the local fishery. This stock should be discontinued as soon as an earlier returning stock can be developed. I recommend that we determine the best possible stock for improving the Juneau area fishery by:

a. Evaluation of 12 wild stocks of coho in the Juneau area that the Department has adipose clipped and coded wire tagged. Evaluation of these fish will include their contribution to the sport and commercial fisheries, and the timing of recoveries of the different stocks in the Juneau area. By comparison of recovery dates of the 12 different stocks, the stock that spends the most time available to the Juneau area fisheries can be selected. Recoveries will be made by monitoring sport and commercial fisheries in the Juneau area, by inspecting samples of sport and commercial salmon catches for marked fish, and by interviewing fishermen to collect catch date and location data.

b. Preliminary data indicate that Yehring Creek (Taku River) adult coho enter the Juneau area approximately three weeks earlier than the existing Mendenhall stock. An experimental Yehring Creek egg take should begin in 1977 for hatchery rearing and release in 1979 from the Mendenhall facility.

2. The capability of saltwater reared coho to adapt to freshwater for release and escapement as adults at the release site should be determined. The Fish Creek saltwater rearing facility located in the estuary of the Mendenhall River is potentially a "high production" facility and in the future will be rearing up to 500,000 coho smolt annually.

a. If it is determined that saltwater reared, freshwater released, coho smolts survive and return to freshwater release sites as adults, smolts from the Fish Creek saltwater rearing facility could be used for development and maintenance of brood stocks at freshwater egg take sites, and to rebuild local depressed stocks of coho.

b. Beginning in spring 1977 a test lot of coho smolts from the saltwater facility should be released from the Mendenhall facility. These smolts would be marked prior to release, so their return as adults to the Mendenhall facility could be determined and compared with that of other releases.

3. Evaluation of the contribution to the fisheries of returning king and coho salmon previously released from the Mendenhall facility should be continued by:

a. Contribution to the fisheries will be determined by methods described in 1-a.

b. Return of various lots of adult salmon to the Mendenhall facility are evaluated by inspecting adult salmon for fin marks and different coded wire tags as they are removed from the adult holding pond for egg takes.

OBJECTIVES

1. Determine feasibility of increasing numbers of coho salmon available to the saltwater sport fishery in the Juneau area by pond rearing of salmon from fry to smolt.

2. Determine feasibility of pond rearing coho fry during the summer and then transferring to local estuarine rearing pens for over-wintering and additional feeding.

3. Establish a reliable source of Mendenhall stock king and coho spawn for future use at the rearing facility.

TECHNIQUES USED

The 1974 brood coho in Moose Lake were fed dry pellet feed until freeze-up on October 16, 1975. Fish were fed Oregon moist pellets with 4.5 gms oxytetracycline per 45.36 kg (100 lbs) for a two-week period prior to freeze-up and from spring break-up until April 26, 1976. All food was broadcast by hand from a 12-foot aluminum skiff as it was rowed around the lake. Records of the amount of feed used were recorded daily.

From April 29 to May 4, 1976, rearing fish were removed from two 6.1 m x 6.1 m x 2.44 m x 48 cm (20 ft x 20 ft x 8 ft x 3/16 in) knotless mesh rearing pens suspended from a floating framework in Moose Lake, to test the feasibility of freshwater pen rearing, as described by Bethers, 1976.

A diesel-powered 5,000-gallon-per-minute pump was used to lower the water level of Moose Lake and to isolate the fish so that all fish could be removed by seining. The pump was set up on May 7, 1976 and operated continously until May 13, when the water level was low enough to allow efficient seining. Rearing fish were removed from Moose Lake on May 13, 1976. A 90.7 m (200 foot) long x 4.57 m (15 foot) x 6.4 cm (1/4-inch) mesh purse seine was used to remove fish from the lake. Fish were transported from seine pursing locations at Moose Lake in 19 liter (5-gallon) plastic buckets to the holding pond for release. The smolts removed from the two rearing pens and a portion of the smolts removed from Moose Lake were retained in two 6.1 m x 6.1 m x 2.44 m (20 ft x 20 ft x 8 ft) deep holding pens in the holding pond for marking. Only one lot of fish was tagged and released at a time. The three lots of 1974 rearing fish from Moose Lake were handled as follows:

	Fish Removed	Fish Tagged	Fish Released
South Pen	April 29	April 29	April 29
North Pen	May 5, 6	May 5, 6	May 5, 6
Moose Lake	May 13	May 18, 19, 20	May 13 - non tagged May 18, 19, 20 - tagged

On May 25, 1976, water from the Dredge Lake system was pumped through the holding pond to cause an "artificial flood," during which, fish remaining in the holding pond were forced out of the pond by use of a 90.7 m x 4.57 m x .64 cm (200 ft x 15 ft x 1/4 in) mesh seine.

A total of 48,231, 1974 brood coho smolts averaging 42/kg (19/pound), which were raised at Crystal Lake Hatchery, were released from the holding pond in 1976. A portion of these smolts (30.5%) were retained in two holding pens in the holding pond for marking and tagging. Non-tagged hatchery-reared smolts were released on May 28, and fish retained for marking and tagging were released on June 1 and 2, 1976. On June 4, 1976 hatchery-reared smolts remaining in the holding pond were forced out by seining. Both non-tagged smolts and sub-smolts released were enumerated by weighing every bucket of fish released, then counting every third bucket to determine the number per pound. Fish considered to be smolts possessed no par marks or coloration of the fins and were usually over 80 mm in length. "Sub-smolts" were usually under 80 mm in length and possessed par marks and reddish coloration in the fins.

All fish marked prior to release were adipose clipped and coded wire tagged (CWT), with a separate code for each of the four lots. Tagging was conducted in a skid shed 2.44 m (8 ft) wide x 3.66 m (12 ft) long with clear visqueen plastic sides and roof, adjacent to the holding pond. Fish for marking were dip netted from the net pens, carried in buckets to an anesthetic (MS-222) trough where they were clipped after being anesthetized. After adipose clipping (Lawton surgical shears No. 19-0305) fish were placed in a holding basket while waiting to be coded-wire-tagged. After tags were injected (N.M.T. MK 1-A injector) fish were dropped into a quality control device (N.M.T.) which separated tagged from non-tagged smolts. Tagged smolts were transferred to the holding pond in approximately one foot of water for recovery. Non-tagged smolts were routed by the quality control device into a bucket for rechecking. Rechecked smolts were dropped through the quality control device an additional two times before they were considered a "re-tag" and placed in the holding basket for "re-tagging." Re-tagged fish were tallied and deducted from the daily number of fish tagged on the injector indicator. Accuracy of the quality control device was checked periodically by use of a N.M.T. field detector. Water pumps used for the tagging operation were two Japsco "Water Mule" 3/4 hp., (13 gpm.) pumps. One was used to fill and circulate water in the anesthetic/clipping troughs, and one was used to provide a water supply for the quality control device. Electric power for the tagging operation was supplied by an Onan diesel 3 kw generator.

Personnel used for adipose fin-clipping and coded-wire-tagging fish consisted of the following:

Personnel	Operation
1	- fish transport, pens to clipping troughs, quality control device operator
2	- fin clippers
1	- handing clipped fish to injector operator
1	- injector operator
5	- person crew

Moose Lake was restocked on June 7, 1976 with 545,000 coho fry which averaged 992 per kg (450 per pound). These fish were from eggs collected from adult coho returning to the Mendenhall facility in fall, 1975.

The 1975 brood coho in Moose Lake were fed dry pellet feed daily, except for a 2-week period prior to the planned transfer of the fish to an estuarine rearing facility, and for the months of October and November when medicated Oregon moist pellets were used. The fish in Moose Lake were fed a minimum of three times daily between 0800 and 1650 hours. The amount of feed used on a given day was determined by the fishes' acceptance of food on that day. During each feeding, fish were fed until the feeding response had nearly ceased. Simply, the fish were fed as long as they appeared to be hungry. If, at first, the fish did not respond in a way that appeared hungry, they were not fed. The amount of feed used was recorded daily. Attempts were made to sample rearing fish in Moose Lake biweekly for average fork lenth, total length and number per pound. Sampling was done June 23, July 7 and 21; August 4 and 18; September 1, 14 and 28; October 13 and 27; November 17; and December 9, 1976.

A statistically sound sampling design by Mike Mills, Sport Fish Biometrician, was used to collect fish growth data. Moose Lake was divided into five sampling areas to insure that fish in all areas of the lake were included in the samples. A sample of at least 1.81 kg (4 lbs) of fish was taken by use of a 9.14 x 2.44 m x .64 cm (30' x 8' x 1/4") mesh purse seine from each of the five areas during a sampling day (at least 200 fish weighing at least 9.1 kg [20 pounds] were taken from the entire lake). Two aluminum row boats were used to operate the seine. Fish food was used to encourage the fish to congregate so that an adequate number for samples could be encircled by the seine which was pursed from one boat. The net was used to collect samples from June 23 through September 23, 1976. The next samples were collected on October 13 when a change in capture method was required because fish were too dispersed to obtain samples. Gee minnow traps baited with cluster salmon eggs were used to catch samples of rearing fish after September 28, 1976. Two traps were used 5 to 15 minutes in each sampling area to obtain adequate samples. Data were collected on the shore of Moose Lake close to the location of capture. Fish measured were first anesthetized in buckets with MS-222 and then lengths were taken in centimeters. After

weighing or measuring, the fish were kept in a floating live box in Moose Lake for recovery. Fish were released at the location of capture after the sample had been processed. On December 9, 1976 Moose Lake was partially frozen and freezing air temperatures prevented measuring of individual fish. On December 9, only number per pound data were collected from a sample consisting of 146 fish.

Arrangements were made with the Alaska Department of Fish and Game Fish Pathology Laboratory in Anchorage, Alaska, to have samples of rearing fish inspected whenever a diseased fish was observed. Samples of fish were collected and prepared according to methods dictated by the laboratory. Methods varied from sample to sample. All samples of rearing fish were packed on ice in a "swinger" ice chest and flown to the Fish Pathology Laboratory in Anchorage.

Juneau saltwater creel census described by Robards (1976) was used to recover marked fish from the Juneau area saltwater sport catch. The Alaska Department of Fish and Game, Commercial Fish Division operates a tagged fish recovery program to determine the contribution of artificially propagated salmon to the Southeast Alaska commercial troll fishery. This program was used to recover adipose and coded wire tagged coho released from the Mendenhall facility taken in the commercial troll fishery. The ratio of marked:unmarked adult coho escaping to the facility was determined. The numbers of marked fish recovered from the sport and commercial fisheries were expanded by the percent of sampling intensity of the sampling program where they were recovered. This number was then expanded again by the marked:unmarked ratio of adult escapement returning to the Mendenhall facility to arrive at an estimate of total Mendenhall fish caught.

An in-migrant trap entrance was placed in the outlet of the holding pond to allow in-migrating salmon access to the holding pond. The trap entrance prevented downstream escapement from the holding pond. Fish were confined to the holding pond by concrete weirs and dikes at the two inlets to the holding pond. In-migrant salmon were held in the holding pond for ripening. King salmon egg takes were performed on September 3, 10, 21, 29, and October 14, 1976. Coho egg takes were performed on October 14, 28, and 29, 1976. During each egg take, fish were seined from the holding pond with a 91.4 m x 4.6 m deep x 2.54 cm (300' x 15' x 1") square mesh seine. Adult salmon were sorted (depending on the fish species, sex, and ripeness) into four live boxes built into the weir on the Dredge Lake inlet to the holding pond. The gametes were taken separately and flown to Crystal Lake Hatchery for fertilization, incubation, and hatching. Spawned adult salmon were enumerated before disposal. Average mideye to fork length of spawned carcasses was determined, and scale samples were taken. Spawned carcasses and excess adult coho were given to the public or charitable institutions, or left along the outlet to replenish the nutrient cycle.

Jack coho seined from the holding pond during egg takes were collected for fin-clip observations. Heads were collected from all adult and jack coho with only a visible adipose fin clip. The heads were taken to the regional Department of Fish and Game Laboratory for detection and

removal of coded wire tags. Tags were read on an N.M.T. coded wire tag jig under a 0.7x - 3x Bausch and Lomb binocular microscope.

Dolly Varden, Salvelinus malma (Walbaum), and cutthroat trout, Salmo clarki Richardson, seined from the holding pond during egg takes were released into the Dredge Lake system.

Rearing fish populations in the lake were maintained through winter by use of aeration systems designed by the Hinde Engineering Company and described by Bethers (1974).

A map of the Mendenhall Rearing Facility is presented in Figure 1.

FINDINGS

1973 Brood Coho, Mendenhall/Blind Slough Stock

Rearing:

A total of 209,485 coho were planted in Moose Lake on September 16, 1974. Fish planted were of two different sizes 109,500 at 403.5/kg (183/lb), and 99,985 at 176/kg (80/lb), and averaged 280/kg (127/lb) after two days of mixing in the lake. The coho in Moose Lake grew from 280/kg (127/lb) on September 16 to 161/kg (73/lb) on October 18. Total survival of 1973 brood coho in Moose Lake was 10,432/209,485 or 4.9%. The ratio of smolt produced to fry planted was 3,904/209,485 or 1.8%. Possible factors responsible for the poor survival of rearing coho in Moose Lake are discussed by Bethers (1976).

Release:

On May 10, 1975, a total of 10,167 coho were released from Moose Lake of which 3,904 were smolts. Of the smolts removed from Moose Lake 1,296 or 33.2% were fin clipped right ventral prior to release into the holding pond for volitional outmigration. Subsmolts were also released into the holding pond for volitional outmigration. No subsmolts were marked.

Two lots of 1973 brood coho smolts reared at Crystal Lake Hatchery were released from the Mendenhall facility in spring 1975 (Bethers, 1976). A summary of all coho releases made at Mendenhall Lakes Rearing Facility in 1975 is presented in Table 1.

Return:

A total of 701 coho jacks (precocious males) of the 1973 brood returned to the Mendenhall Lakes Rearing facility in fall, 1975. An additional 27 jacks destined for the Mendenhall facility were taken by sport fishermen from the Mendenhall River downstream from the rearing facility.

A total of 89, 1973 brood adult coho from a lot of hatchery-reared coded wire tagged smolts released from the Mendenhall facility were estimated to have been taken by Juneau area marine sport fishermen and 1,064 of

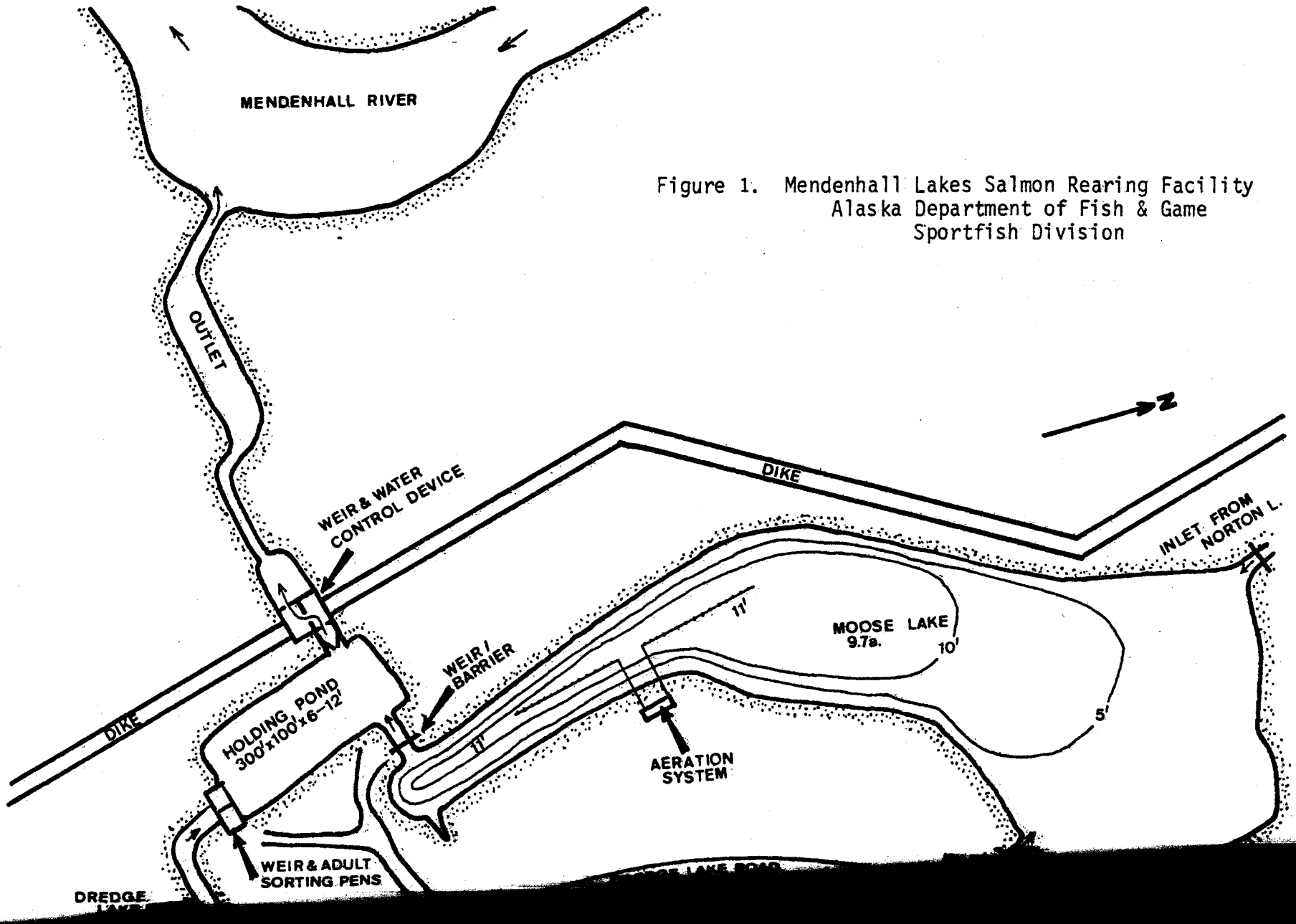


Figure 1. Mendenhall Lakes Salmon Rearing Facility
Alaska Department of Fish & Game
Sportfish Division

Table 1. A Summary of Coho Fry Planted and Coho Smolts Released at the Mendenhall Lakes Salmon Rearing Facility.

Brood Year	Stock	Number Planted	Planted Size	Date	Number Released	Released Size	Date	Number Marked	Percent Marked	Mark
1972	Mendenhall & Blind Slough	271,744	578/kg 262/lb	08/07/73	81,425	137/kg 62/lb	04/7/74	24,825	30.5	Ad
			1974 Total Released		81,425					
1973	Mendenhall & Blind Slough	209,485	280/kg 127/lb	09/16/74	3,904	161/kg 73/lb	05/10/75	1,296	33.2	R.V.
	Blind Slough	Smolt imprints from Crystal Lake Hatchery			50,200	31/kg 14/lb	05/19-06/06/75	15,200	30.2	Ad & CWT 4-2-6
	Blind Slough	Smolt imprints from Crystal Lake Hatchery			46,429	31/kg 14/lb	05/19-06/06/75	46,479	100.0	Ad & 1/2D
			1975 Total Released		100,583		1975 Total Marked	62,975		
1974	Mendenhall & Blind Slough Moose Lake	A) 134,500	661/kg 300/lb	06/24/75	38,694	53/kg 25/lb	05/13-20/76	14,180	36.6	Ad & CWT 4-4-2
	Mendenhall & Blind Slough North Pen	B) 10,000	300/lb 300/lb	06/24/75	4,233	90/kg 24/lb	05/05-06/76	4,233	100.0	Ad & CWT 4-4-4
	Mendenhall & Blind Slough South Pen	C) 5,000	661/kg 300/lb	06/24/75	2,430	70/kg 41/lb	04/29/76	2,430	100.0	Ad & CWT 4-4-3
	Blind Slough	Smolt imprints from Crystal Lake Hatchery			42,231	42/kg 19/lb	05/28-06/02/76	14,695	30.5	Ad & CWT 4-4-14
			1976 Total Released		93,588		1976 Total Marked	35,538		
1975	Mendenhall	545,000	992/kg 450/lb	06/07/76	99,439	66/kg 30/lb	09/16-09/18/76			
			1976 Total Released (1975 brood)		99,439					

the same lot by commercial trollers, mostly in "outside" and Icy Straits fisheries. Because commercial fishery sampling programs do not recognize single fin marks; the contribution to the commercial fishery of right ventral marked fish released from Moose Lake is not known. Evaluation in the fisheries of a lot of hatchery reared adipose plus half dorsal fin clipped coho released from the Mendenhall facility was made impossible by two subsequent releases of identically marked fish in the Juneau area and at Crystal Lake Hatchery by the Hatcheries Section. Locations and catch dates of Mendenhall tagged adult coho recovered by commercial trollers in 1976 are presented in Figure 2. Locations and catch dates of Mendenhall-marked king and coho taken by Juneau area marine sport fishermen in 1976 are presented in Figure 3. Recovery information collected at the Mendenhall Rearing Facility on 1973 brood coho is presented in Table 2.

A total of 3,501, 1973 brood adult coho returned to the Mendenhall Lakes Rearing facility in fall, 1976. Unfortunately the release lot that the returning fish belonged to could not be determined because the marked to unmarked ratio of fish released was much higher than the marked:unmarked ratio of fish returning to the facility. I feel a higher mortality rate of marked fish and regeneration of poorly clipped fins were the major causes. Therefore, the marked:unmarked ratio of fish returning to the facility rather than the marked:unmarked ratio of each lot of released fish was used to expand the number of marked fish caught to the total number of fish caught. A summary of all catch and returns of coho released from the Mendenhall Lakes Rearing facility is presented in Table 2. The average mid-eye/fork lengths by sex and mark of 1973 brood coho returning to the Mendenhall facility in fall, 1976 is presented in Table 4.

A total of 248 females were spawned and approximately 1,008,000 eggs were taken. Average fecundity was 4,064 eggs per female. Eggs were flown to Crystal Lake Hatchery for incubation.

A total of 2,480 adult coho and 249 jack coho were distributed to the public at advertised "Fish Give-Aways."

1974 Brood Coho, Mendenhall/Blind Slough Stock

Rearing:

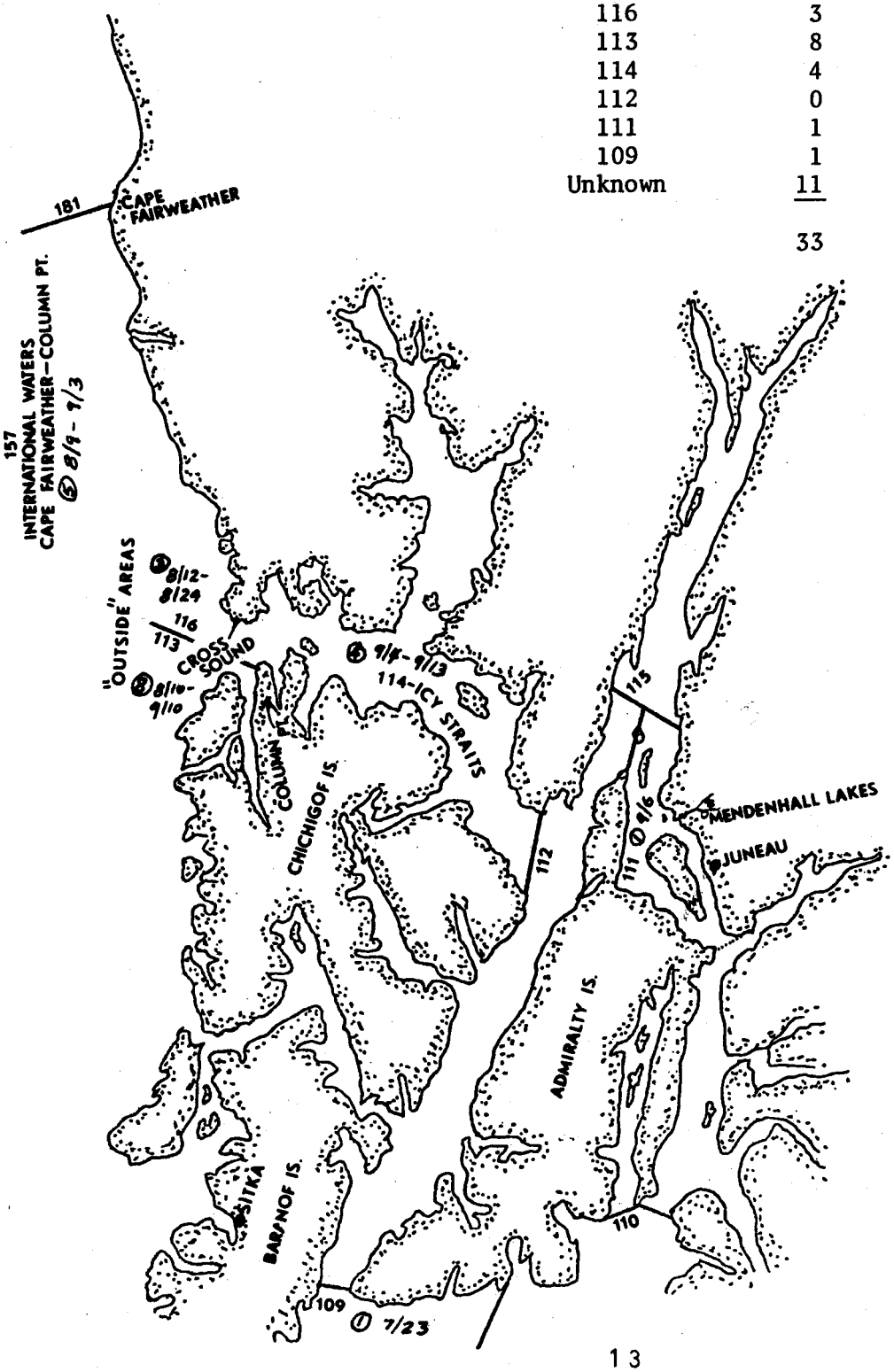
On June 24, 1975, Moose Lake was stocked with 134,500 coho fry. One rearing pen was stocked with 5,000 coho fry and the other with 10,000 coho fry. All fish stocked were 1974 brood, Mendenhall/Blind Slough stock coho which averaged 661/kg (300/lb) at stocking.

Length and weight data were taken on fish in rearing pens and free-ranging fish in Moose Lake so that a comparison of fish production in the pens and in the lake could be made.

A comparison of survival from planting to release and average length of 1974 brood coho smolt reared in Moose Lake is presented in Table 5.

Figure 2. Locations and catch dates of Mendenhall Lakes-released coded wire tagged adult coho taken in the commercial troll fishery, 1976. Circled numbers indicate numbers of marked fish recovered on the given dates.

Comm. Reg. Area	Tagged Fish Recovered	Est. Total
157	5	161
116	3	97
113	8	258
114	4	129
112	0	0
111	1	32
109	1	32
Unknown	11	355
	33	1,064



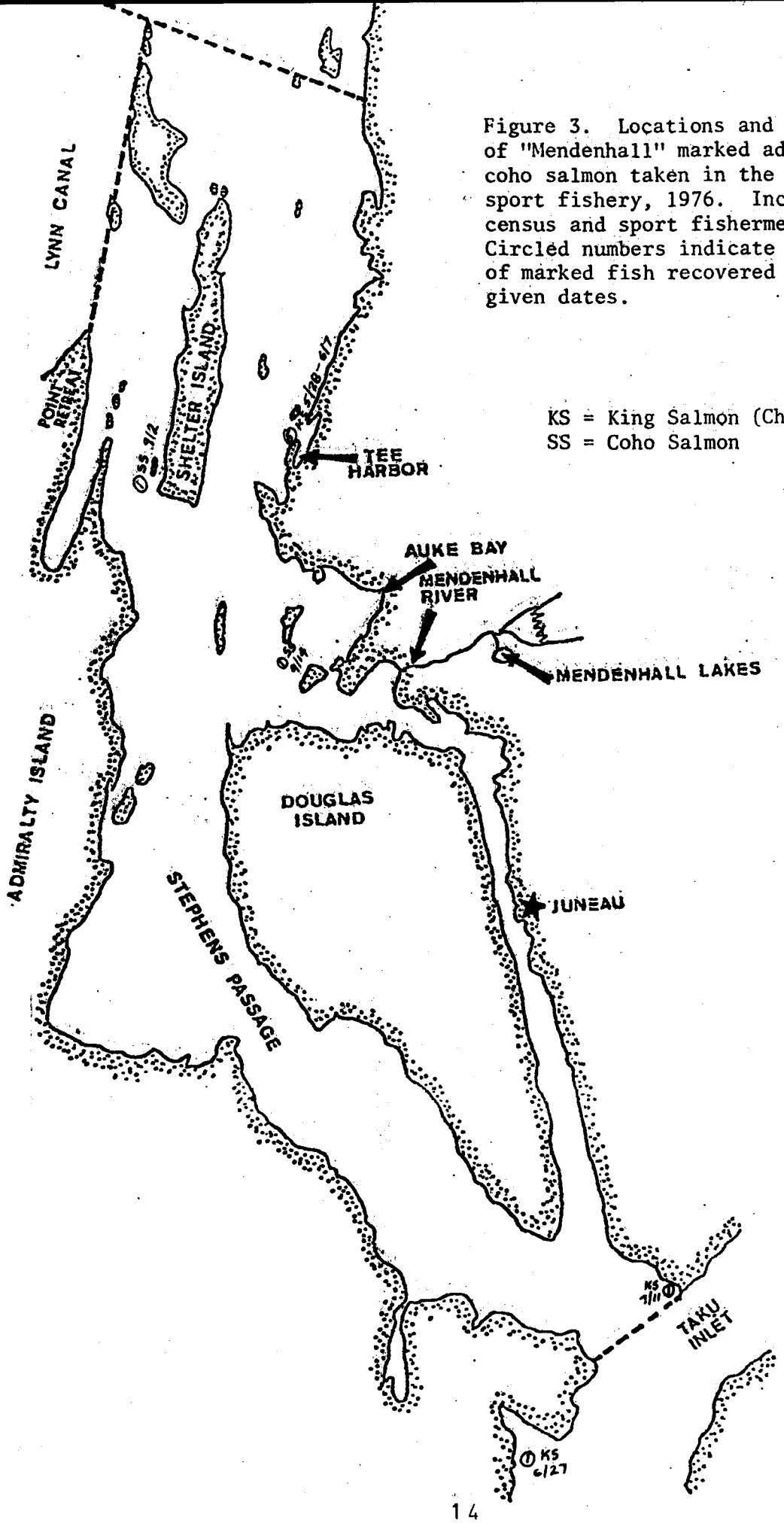


Figure 3. Locations and catch d
of "Mendenhall" marked adult kin
coho salmon taken in the Juneau
sport fishery, 1976. Includes c
census and sport fishermen report
Circled numbers indicate the numb
of marked fish recovered on the
given dates.

KS = King Salmon (Chinook)
SS = Coho Salmon

Table 2. A summary of catch and returns of coho salmon released from the Mendenhall Lakes Salmon Rearing Facility.

Brood Year		Total Released	Release Size	Percent Marked	Sport Catch Jack	Sport Catch Adult	Commercial Catch	Escapement Jack	Escapement Adult	Total	Percent Return
1972		81,425	137/kg 62/lb	30.5 Ad	0	333*	901	614	6,774**	8,622	10.6%
Total		81,425				333	901	614	6,774	8,622	10.6%
1973	a.	Moose L. 3,904	161/kg 73/lb	33.2 R.V.	0	0	0	***	***	***	3.6%
	b.	Crystal L. 50,200	31/kg 14/lb	30.3 Ad & CWT	18	99	1,209	***	***	***	1.9%
	c.	Crystal L. 46,429	31/kg 14/lb	100.0 Ad & 1/2D	9	0	0	***	***	***	0.4%
Total		100,583			27	99	1,209	701	3,501	5,537	5.5%
1974	a.	Moose L. 38,694	53/kg 24/lb	36.6 Ad & CWT 4-4-2	0			253			
	b.	North Pen 4,230	90/kg 41/lb	100.0 Ad & CWT 4-4-4	0			3			
	c.	South Pen 2,430	71/kg 32/lb	100.0 Ad & CWT 4-4-3	0			0			

Table 2. A summary of catch and returns of coho salmon released from the Mendenhall Lakes Salmon Rearing Facility (Cont'd).

Brood Year	Total Released	Release Size	Percent Marked	Sport Catch Jack	Sport Catch Adult	Commercial Catch	Escapement Jack	Escapement Adult	Total	Percent Return
1974 d. Crystal L.	48,231	19/lb	30.5 Ad & CWT 4-4-14 non-marked				141			
		-					322			
Total	93,585						719			

* Includes 11 fish taken in Mendenhall River and 18 recovered by marine creel census October 1 through October 5, 1975.

** Includes an estimated 1,500 fish which spawned naturally in Mendenhall River.

*** Returns could not be attributed to a particular lot because of differential mortality of marked fish and fin regeneration of clipped fins.

Table 3. Summary of Adult Coho (1973 brood) Returns from Smolts Released from the Mendenhall Rearing Facility, 1976.

Mark	Smolt Releases Total	Clipped	%	Adult Returns SF Catch* (n)	Expanded	CF Catch (n)	Expanded	Escapement (n) Non-marked	Total Estimated Return
R.V. (Lot a)	3,904	1,296	33.0	(0)	0	(0)	0	(44)	
Ad + 4-2-6 (Lot b)	50,200	15,200	30.3	(1)	89	(33)	1,064	(52)	
Ad + 1/2D (Lot c)	46,529	46,529	100.0	(0)	0	(0)	0	(74)	
	100,583	63,025	62.7%		89**		1,064***	3,501****	4,654*****

* n = number of marked fish recovered.

** Sport Catch: One marked fish was recovered in a 22.2% sample of the sport catch. One mark expanded to total sport catch and then by 19.6:1, the unmarked:marked ratio of adult coho escapement.

*** Commercial Catch: 33 marked fish were recovered in a 60.76% sample of the troll catch. 33 marks expanded to total sport catch and then by 19.6:1, the unmarked:marked ratio of adult coho escapement.

**** Total escapement included 170 marked fish.

***** Total estimated return includes jack catch escapement.

Table 4. Average mideye-fork length by sex and mark of 1973 brood adult coho returning to Mendenhall Lakes Rearing Facility, fall 1976.

Mark	Male	Female	Average Length/Mark
R.V.	(16) 644.6 mm	(14) 660.4 mm	(30) 652.0 mm
Ad + CWT 4-2-6	(13) 663.9	(25) 677.0	(38) 672.6
Ad + ½D	(23) 646.4	(30) 664.0	(53) 656.4
Ad + CWT 4-2-12*	(8) 623.5 mm	(7) 669.7	(15) 645.0 mm
Average Length/Sex	(60) 646.7	(76) 668.2 mm	(136) 658.7

* Released from Fish Creek Estuarine Rearing Facility.

Table 5. A comparison of survival from planting to release and average fork length and number per pound at release of 1974 brood coho salmon reared in Moose Lake, 1975 and 1976.

	Moose Lake	North Pen	South Pen
No. planted (661/kg) (300/1b)	139,500	10,000	5,000
No. released (total)	39,952 (28.6%)	5,080 (50.8%)	3,071 (61.4%)
Smolts No. released/plant	38,694 (27.7%)	4,233 (42.3%)	2,470 (49.4%)
Average no./kg	52.9	90.4	70.5
Average no./1b	24	41	32
Average total length	141.0 mm	111.8 mm	111.4 mm
No. subsmolts	1,258 (3.1%)	487 (9.6%)	601 (19.6%)

Release:

A summary of 1974 brood coho marked and released from the Mendenhall Lakes Rearing facility in 1976 follows:

	No. Released	No. Tagged	Ad+ CWT
Moose Lake	38,694	14,180 (36.6%)	4-4-2
South Pen	2,430	2,430 (100.0%)	4-4-3
North Pen	4,233	4,233 (100.0%)	4-4-4
C.L. Hatchery	48,231	14,695 (30.5%)	4-4-14
Total	93,588	35,538 (38.0%)	

Return:

A total of 719, 1974 brood coho jacks returned to the Mendenhall Rearing Facility in fall, 1976. According to expansions using marked:non-marked ratios of released smolts and percent sampled, 396 (55.1%) jacks returned from the four marked lots and 323 (44.9%) were non-marked and could not be specifically attributed to one of the four released lots. Again, greater mortality of tagged than untagged fish was indicated.

The estimated jack return and average mideye fork length of jacks by release lot is presented below:

	Moose Lake	North Pen	South Pen	Crystal Lake Hatchery
Estimated return* (number sampled)	(93) 253	(3) 3	(0) 0	(43) 141
Avg. mideye fork length (mm) (number sampled)	(70) 340.9	(2) 337.0	(0) -	(34) 338.4

* Estimates based on release mark:unmark ratios.

1975 Brood Coho, Mendenhall Stock

Rearing:

Moose Lake was stocked with 545,000 coho fry which averaged 992/kg (450/lb) on June 7, 1976. These fish were of Mendenhall stock.

Feeding of the 1975 brood coho in Moose Lake began on June 8, and continued until ice made feeding impossible on December 1, 1976. The total amounts of food fed to the fish in Moose Lake were: dry pellets, 4080 kg (8,994 lbs), Medicated Oregon Moist Pellets, 519 kg (1,145 lbs) Length and weight data collected on 1975 brood coho rearing in Moose Lake is presented in Table 6.

Table 6. Average total length, fork length, number per kilogram and per pound, and conversions from fork to total length and the fork length of 1973 brood coho reared in Moose Lake, 1976.

Date	No. Obs.	Average Length (mm) Total	I.S.D.	Average Length (mm) Fork	I.S.D.	No./kg	No./lb	Conversions Total→Fork	Fork→Total
06-07	---	---	---	---	---	992	450	---	---
06-23	200	57.2	6.04	53.4	5.68	880	399	.93343	1.07094
07-07	201	65.4	8.96	61.0	8.22	306	139	.93181	1.07301
07-21	199	79.0	8.73	73.4	8.05	203	92	.92815	1.07718
08-04	200	86.2	9.02	79.6	8.26	137	62	.92379	1.08232
08-18	199	92.6	11.12	86.0	10.41	112	51	.92830	1.07702
09-01	200	102.9	10.95	95.1	9.96	82	37	.92405	1.08202
09-14	202	109.1	11.40	100.8	10.51	71	32	.92404	1.08199
09-28*	200	105.3	15.74	97.1	16.09	79	36	.92184	1.07891
10-13*	198	107.9	17.21	98.9	15.59	79	36	.91629	1.09108
10-27*	200	106.0	15.50	97.1	14.12	90	41	.91607	1.09148
11-17*	200	100.3	17.87	92.1	16.30	123	56	.91793	1.08923
12-19**	146	---	---	---	---	99	45	---	---

* Data collected from fish collected in minnow traps.

** Lake froze over.

On September 16, 17, and 18, 1976, a total of 99,439 coho averaging 66/kg (30/lb) in "near smolt" condition were transferred from Moose Lake to Fish Creek Estuarine Rearing Facility operated by the Division of Fisheries Research, Enhancement and Development for overwintering and spring release.

Samples of 1975 brood rearing coho analyzed by the pathology laboratory in Anchorage were found to contain metazoan eggs in the gills and body cavities. These structures were also observed in 1974 brood coho reared in Moose Lake. No positive identification of the parasite has been made because we have been unable to collect an adult form of the parasite. It is not known if the eggs can or will do permanent damage to the fish.

On September 15, 1976, one fish in a sample of six analyzed by the pathology laboratory was found to have chronic bacterial kidney disease infection. On September 17, 1976, a sample of 50 handling mortalities incurred in transfer from Moose Lake to Fish Creek Rearing Facility was examined by the pathology laboratory. Stained kidney smears showed 16 (32%) of the mortalities were infected with bacterial kidney disease. Pathological analysis on January 20, 1977, of a sample of Moose Lake reared coho showed little change in the level and infection among the rearing fish. It appears that bacterial kidney disease may be an important factor in overwinter mortality.

King Salmon Production, 1972 Brood, Carson River, Washington Stock

Rearing:

A total of 155,078 king salmon fry were planted in Moose Lake from September 25 to October 1, 1973. The fry averaged 66.8/kg (30.3/lb) and were of Carson River, Washington, origin. Total survival of fish in Moose Lake was 95,731/155,078 or 61%. The percent of smolt produced from fry planted was 93,731/155,078 or 60%. Smolts removed from Moose Lake in spring 1974 averaged 60/kg (27/lb).

Release:

A total of 217,438, 1972 brood Carson king smolts were released from the Mendenhall Lakes Rearing facility in spring 1974. Of these, 93,129 had been reared in Moose Lake and 124,307 at Crystal Lake Hatchery. To compare survival and return of Moose Lake reared chinook to hatchery reared king, the hatchery fish were marked with a half dorsal fin clip and 39,560/93,129 or 42.5% of the Moose Lake kings were marked with adipose fin clips prior to release. A summary of king salmon reared at the Mendenhall Lakes Rearing Facility and smolts released from the facility is presented in Table 7.

Return:

In August 1974, when the pump was set up at Moose Lake for evacuation of water and residual fish, the pump outlet was directed into the Mendenhall River. A total of 15 small king salmon jacks were attracted to the pump outwash which varied from .08 to .16 cms (3 to 6 cfs) of flow. Of these

Table 7. A Summary of King Salmon Fry Planted and Smolts Released at the Mendenhall Lakes Rearing Facility.

Brood Year	Lot	Stock	Planted Number	Planted Size	Planted Date	Released Number	Released Size	Released Date	Percent Marked	Mark
1972	a.	Carson, WA	155,078	33/lb	09/25/73	93,129	60/kg 27/lb	06/74	39,560 42.4	Ad
	b.	Carson, WA	Smolt imprints from Crystal Lake Hatchery			124,307	29/kg 13/lb	06/74	124,307 100.0	½D

fish, 4 were from Moose Lake and 11 were from Crystal Lake Hatchery. Scales of these fish showed no saltwater growth. Presumably these fish had been inhabiting fresh water of the Mendenhall River system since their release.

During October, 1974, eight king salmon jacks were collected in the inmigrant weir. Of these fish, one was from Moose Lake and seven were from smolts raised at Crystal Lake Hatchery. Scales of these fish showed no saltwater growth.

An estimated 40 spring king salmon from smolts released from the Mendenhall Lakes Rearing facility in 1974 were taken by Juneau area marine sport fishermen from May 23 to July 11, 1976, (Robards, 1977). Of these, 32 were from smolts reared in Moose Lake and eight were from smolts reared at Crystal Lake Hatchery. The average total length of king salmon taken in the sport fishery from Mendenhall reared smolts was 742.6 mm (29 1/4 inches and averaged total length of king salmon from hatchery reared smolts was 770 mm (30 1/4 inches). The contribution of Mendenhall released king salmon to the commercial fisheries is not known because coast-wide commercial fishery sampling programs do not recognize single fin marks. Catch dates and locations of Mendenhall marked king salmon taken by Juneau area marine sport fishermen are presented in Figure 3. A summary of all catch and return of king salmon released from the Mendenhall Lakes Salmon Rearing facility is presented in Table 8.

The estimated escapement lengths by sex and mark of 1972 brood king salmon returns in 1976 are presented in Table 9.

A total of 58 females were spawned and approximately 225,000 eggs were taken. Average fecundity was 3,879 eggs per female. Eggs were flown to Crystal Lake Hatchery for incubation.

Considerable straying of the returning Carson spring kings was realized, as at least 33 adult kings were discovered in Montana, McGinnis, and Steep Creeks, all in the Mendenhall watershed. The Mendenhall system was not known to have a natural stock of king salmon.

A total of 125 Dolly Varden and seven cutthroat trout seined from the holding pond were released in the Dredge Lake system for overwintering.

DISCUSSION

1973 Brood Stock

A total of 99, 1973 brood adult coho from Mendenhall releases were estimated to have been taken in the Juneau area sport fishery in 1976 (Figure 3). This catch indicates a low contribution of the facility to the sport fishery when compared to 333 adult coho taken in 1975. In 1975, returns of wild coho to the Juneau area were very low and subsequently the commercial troll fishery was closed on August 15, 1975. The Juneau salmon sport fishery was the only fishery existing after August 15.

Table 8. A Summary of catch and returns of spring king salmon released from the Mendenhall Lakes Rearing Facility.

Brood Year	Lot	Date Released	Number Released	Number Marked	%	Mark	Yr.	Catch Sport	Catch Comm.	Escapement	Total Return
1972	a.	06/74	93,129	39,560	42.5	Ad	'74	0	0	4	4
							'75	0	0	0	0
							'76	32	?	126	158
							'77				
							'78				
							Total	32		130	162
1972	b.	06/74	124,309	124,309	100.0	½D	'74	0	0	11	11
							'75	0	0	0	0
							'76	8	?	58	66
							'77				
							'78				
							Total	8		69	77

Table 9. Estimated escapement and average mideye-fork length by sex and mark of 1972 brood (age 1:2) king salmon returns to the Mendenhall Lakes Rearing Facility, 1976.

Mark	Number Smolt Released	Estimated Return					
		Male		Female		Total	
		Number	Length	Number	Length	Number	Length
Adipose	93,129	56 (38)*	678 mm (37)	70 (47)	669 mm (46)	126 (85)	673 mm (83)
1/2 Dorsal	124,309	16 (11)	672 mm (10)	42 (28)	683 mm (28)	58 (39)	673 mm (38)
TOTAL	217,438	72 (49)	677 mm (47)	112 (75)	674 mm (74)	184 (124)	675 mm (121)

()* Actual number of fish sampled.

Thus, with only a sport fishery and low available numbers of wild coho present, the Mendenhall-reared coho bolstered the sport catch by 333/5,457 or 6.1%. In 1976 the contribution of Mendenhall released coho to the local sport fishery was 89/7,646 or 1.1%.

Catch data and location data presented in Figures 2 and 3 may be misleading because different fishing locations receive different intensities of fishing pressure. Both sport and commercial fishermen tend to fish areas known to be productive rather than fishing over large areas of unknown productivity. Because of this, Figures 2 and 3 show only the catch dates and locations and not the distribution of adult salmon from Mendenhall released smolts. Had all fishing locations received equal fishing pressure, the catch distribution of artificially reared salmon would possibly have been different.

Commercial catch data presented in Figure 2 indicate that in early September, Mendenhall released coho were spread through statistical areas 116, 114, and 111 (Cross Sound to local Juneau areas). Because of the large area in which in-migrating mature Mendenhall coho were found, the large numbers of intermixed wild stocks of coho, and the small commercial catch in area 111 (Juneau), it would be very difficult to manage the commercial troll fishery to maximize harvest of Mendenhall reared coho.

Catch data collected in 1976 indicate that Mendenhall stock coho returning to both the Mendenhall Lakes and the Fish Creek Rearing Facilities entered the Juneau area about August 20. In 1975, the Mendenhall stock adult coho entered the Juneau area from August 21 to 26. The low contribution of artificially reared coho to the sport fishery could be due to the Mendenhall stock of coho returning to the Juneau area during the peak of the commercial troll season and after the peak of the Juneau area marine sport fishery. Also, because the Mendenhall stock is a short-run, late returning stock, a portion of the returning adults may enter the Juneau area in a "non-biting" condition which is common with coho prior to ascending spawning streams. This condition would limit the number of fish available to both the sport and commercial troll fisheries in the Juneau area.

We believe that we will have the greatest chance of bolstering the Juneau area sport catch by developing a stock of coho that returns to the Juneau area early in the season and spends more time available to the Juneau area sport fishery prior to August 15, the opening of the local commercial troll season. If a broodstock from these early returning coho were developed for artificial propagation, perhaps the Juneau area sport catch would be significantly bolstered.

The percent total return of the 1973 brood coho (all lots combined) was 5,537/100,583 or 5.5%. Individual release lots can only be compared by comparing the actual number of marks recovered from each lot, and the total number of marks released per lot.

Factors capable of affecting return rates of all lots of released fish include different mark mortality and regeneration factors of different

marks used, different percentages of smolts marked from the three lots, and our inability to recover coho lots marked right ventral or adipose plus half dorsal in the commercial fishery for reasons explained in the findings.

The difference in percent of mark return per lot between Moose Lake-reared and hatchery-reared coho is probably related to differences in rearing habitat. One might assume that the Moose Lake-reared smolts, being raised in a "semiwild" environment would be more capable of survival in the marine environment than smolts reared in artificial hatchery conditions. Also, some hatchery-reared smolts may have imprinted on Crystal Lake Hatchery water prior to transfer to the Mendenhall facility for release, as at least 37 adult coho from the lot of hatchery-reared, adipose and coded wire tagged coho released from the Mendenhall facility were recovered in northern statistical area 109 (Figure 2). These fish may have been returning to the Mendenhall facility via Chatham Strait, or to Crystal Lake Hatchery to the south.

Two lots of hatchery reared smolts released after imprinting from the Mendenhall facility were virtually the same except for fin marks used and percent of the lots marked. Both lots had been handled twice in marking at Crystal Lake Hatchery prior to transfer to the Mendenhall facility for release.

Data collected by the Commercial Fishery tag recovery program indicate that only 18 adult coho marked adipose and half dorsal were recovered during the season. A total of 523,563, 1973 brood coho marked adipose plus half dorsal were released at four locations in Southeast Alaska in 1975. Judging from the commercial recovery of these fish, survival of all releases of the adipose and half dorsal marked coho must have been very low.

According to Dan Romey, Crystal Lake Hatchery manager, the return of the adipose plus half dorsal marked 1973 brood to the hatchery was 6,500/449,000 or 1.4%. The half dorsal clip was 100% regenerated on approximately 50% of the returning adults. The adipose fin was regenerated on approximately 25% of the returning adults and approximately 25% retained both adipose and half dorsal fin marks. Perhaps quality control of fin marks applied to this lot of fish was poor and subsequent fin clip regeneration could have caused lower than actual estimates of return to the fisheries and to the Mendenhall facility. A total of 1,457 adipose "only" marked adult coho were recovered in the commercial fishery, seven adipose "only" in the Juneau sport fishery and 97 adipose "only" returned to the Mendenhall facility. These adipose "only" marked coho may have been from the adipose plus half dorsal lots with regenerated dorsal fins or from adipose plus coded wire tagged lots with lost wire tags.

It is unfortunate that these apparently artificially reared fish can not be identified to a release lot for evaluation purposes.

As indicated in the findings, nearly 90% of the adult coho returning to the Mendenhall facility in 1976 were non-marked and could not be attributed to any of the three release lots when expanded by the marked:unmarked

ratio of smolts released. Scales were not routinely collected from adult coho returning to the facility until it was realized that the mark:unmark ratio was far from the expected 62%. Scale samples (n=43) taken from the last few coho returning to the Mendenhall facility in 1976 indicate that 95% (n=41) of the unmarked coho were of the expected 1973 brood and 5.0% (n=2) were apparently 1972 brood coho that entered saltwater as 2-year old smolts.

Factors responsible for the low percent marked return and large number of non-marked adult coho returning to the Mendenhall facility in 1976 apparently include low survival of fin marked smolts, low survival and dorsal fin regeneration of the adipose plus half dorsal marked lot of smolts, and the small unexpected return of 1972 brood coho.

Of these factors, the one having the greatest effect on the ratio of marked to unmarked adult coho returning in 1976 was the apparent low survival of the adipose plus half dorsal lot of coho. This lot contained 63% of the marked smolts released in spring 1975. This condition is suspect of being a major cause of the 3,129 unmarked adult coho returning to Mendenhall Lakes in 1976. Our prediction of numbers of returning unmarked fish was based on an expansion of the return of marked fish. Since the marked fish experienced a disproportionately high mortality, the proportion of unmarked fish increased, accounting for the relatively high return of unmarked fish. The return of some 1972 brood coho also increased the number of unmarked fish returning, though this was probably a less significant factor. The small sample of adult coho scales collected can be used only as an indicator; however, it indicated that approximately 156 non-marked adults may have been from 1972 brood smolts. These fish may have escaped from Dredge Lake in 1973 or they may have been released in 1974 as subsmolts which then remained in fresh water an additional year prior to entering salt water.

The "fish give-away" program was well accepted by the public as 27,500 pounds of coho were distributed to the public during three "fish give-aways" totalling three hours total time. Individuals were given a maximum of 12 fish each and most recipients indicated the fish would be used for crab bait or smoked for human consumption. Even though considerable goodwill was demonstrated by the Department in handing out free salmon, numerous irate citizens voiced complaints because of the lack of fish, quality of fish, location of "give-away" and for other reasons. Most people receiving fish would have taken many more than the 12 fish per person quota.

The give-away was the best way to dispose of the excess salmon when they returned upstream. However, it would have been desirable to have had a limited drift gillnet fishery in Fritz Cove to harvest excess coho. There, the fish would have been worth considerable monetary value to the fisherman and of high value as food fish. Approximately 2,500 adult coho could have been taken by the fisheries without reducing the number of eggs taken for brood stock maintenance.

1974 Brood Coho:

Percent survival of free-ranging coho reared in Moose Lake and in two net pens within Moose Lake (one with 10,000 fish and one with 5,000 fish) was 28.6%, 50.8% and 61.4% respectively. Smolts released from the North pen (originally stocked with 10,000 fry) averaged 90 kg (41/1b), compared to 71 kg (32/1b) for smolts released from the South pen (originally stocked with 5,000 fry). Fish in both pens were fed according to the fishes acceptance of food on a given day. Perhaps the greater size at release and survival of fish in the South pen was due to better utilization of artificial food and less competition for natural food available in the net pens.

The percents of subsmolts of the total fish removed from Moose Lake, North pen and South pen were 3.1%, 9.7%, and 19.8% respectively. The survival (percent) of subsmolts removed from the lake and two rearing pens was directly proportional to the size of smolts released from the three lots. Canabalism by larger smolts is believed to be responsible for the lower survival of subsmolts in Moose Lake.

The most important factor responsible for 322 "un-marked unaccounted for" 1974 brood coho jacks returning to the facility in 1976 is again probably the heavier than expected mortality of marked smolts. These 322 jacks were "unaccounted for" only in terms of the original ratio of marked to unmarked fish. Differential mortality of the marked and unmarked smolts would affect the ratio of marked:unmarked smolts actually released and could subsequently cause lower than actual estimates of unmarked return per lot.

Jack coho returning from Moose Lake-reared smolts returned at approximately twice (253[.65%] vs. 141[.29%]) the rate of jacks returning from hatchery-reared smolts released at the facility. This is probably related to rearing environment, imprinting characteristics and marine survival of pond-reared and hatchery-reared smolts as discussed earlier under 1973 brood coho.

Perhaps in the future, after several adult coho returns, jack coho return data can be used to predict adult coho returns. This type of information would be valuable for management purposes.

Jack return from smolts reared in the North pen totaled three fish or 0.07%. No jack recoveries were made from South pen-reared smolts.

Further comparison of the four lots of 1974 brood coho will be presented in the next annual report of progress.

1975 Brood Coho:

All 1975 brood coho fry planted in Moose Lake in 1976 were from eggs taken from adult coho returning to the Mendenhall facility. The first year that an abundance of Mendenhall stock coho fry were available was 1976 and our stocking request for Moose Lake could be filled without mixing Mendenhall and Blind Slough stocks of coho.

Moose Lake was stocked with 545,000 coho fry in an attempt to insure at least 200,000 smolts for transfer to saltwater pens for over-wintering and spring release. This density, approximately 22,700 per surface hectare (56,000 per surface acre), appeared to be an overload for Moose Lake, especially with the environmental conditions that occurred during summer, 1976.

The first problem incurred was severe predation of rearing fish by Arctic terns. Predation by terns occurred from planting of fry on June 7 until late July when terns normally migrate from the Juneau area. The number of terns feeding at Moose Lake gradually increased until the last of July when 30 to 40 terns were present at one time.

The tern predation was due to at least two factors: first, the draining and excavation of a local lake normally used for feeding by the seasonal tern population and second, the large numbers of coho fry visible in Moose Lake. The terns were probably attracted by the high visibility of the fish. Scare devices including automobile horns, shell crackers and falcon silhouettes atop poles were tried in attempts to deter the terns, however no effective method was found. After all scare tactics failed, attempts were made to capture and mark several terns so that individual feeding habits could be observed and estimates of rearing fish taken by terns could be made. Both mist nets and dipnets were tried with no success as the terns were agile flyers and able to avoid the nets. The terns migrated out of the area before any data could be collected, or control measures used.

Water levels at Moose Lake were lower in the summer of 1976 than at any time since the beginning of the project and, subsequently, water flow through Moose Lake was very low.

Warm weather during late July and early August combined with low flow through Moose Lake caused surface temperatures of 20.5°C (69°F) to 22.2°C (72°F) the first week of August 1976. With the high density of rearing fish, low water flow and warm water in Moose Lake, the potential for stress related disease was extreme. These conditions are probably responsible for mortality which on September 15 was determined to be from bacterial kidney disease. Had we known prior to planting that fry destined for Moose Lake had been exposed to bacterial kidney disease at Crystal Lake Hatchery, they would have been stocked in Moose Lake at a much lower density.

On September 16, 17, and 18, 1976, a total of 99,439 coho in "near smolt" condition were seined from Moose Lake and transported to the Fish Creek Estuarine Rearing Facility for overwintering and release. This was approximately 50% of the 200,000 fish requested for the Fish Creek Facility. Transfer operations were stopped when it became apparent that 200,000 fish could not be seined from Moose Lake. The number of fish left in Moose Lake for overwintering was estimated to be 40,000 to 60,000 fish.

The small purse seine used to sample rearing fish in Moose Lake for length and weight data functioned perfectly from planting through

September 14. On the next sampling date, September 28, rearing fish could not be captured with the seine. This sampling technique had been used at Moose Lake for two seasons and had never before failed to catch fish. Perhaps the seining of fish from Moose Lake on September 16, 17, and 18 for transfer to Fish Creek Rearing Facility was responsible for the failure of sampling techniques. It is known that the most dense schools of rearing fish were removed from Moose Lake for transfer to Fish Creek. Perhaps fish left in Moose Lake were scattered throughout the lake in such a way that the chum used when seining would not attract adequate numbers for effective seining.

Length and weight samples collected from September 28 through freeze-up by use of minnow traps indicated that rearing fish in Moose Lake were getting smaller. Since these samples were taken by a different method, the statistical validity is questionable.

Fish transferred to the Fish Creek Saltwater Rearing Facility averaged 66/kg (30/lb) and approximately 104 mm (4.1 inches) fork length. Fish requested for the saltwater facility were to be at least 80 mm (3.2 inches) in fork length as fish at this size appear capable of adapting to full strength salt water. According to growth data collected (Table 6) rearing fish could have been transferred to the Fish Creek facility as early as August 18, 1976. It is planned to transfer a lot of the saltwater reared smolts back to the Mendenhall facility for imprinting and release in spring, 1977. This imprint study will provide information valuable to future rehabilitation work.

The feasibility of maintaining brood stocks of both king and coho salmon at the Mendenhall Facility in its current status is questionable. In May 1976, the first adult king salmon returned to the holding pond. King salmon continued to trickle into the facility through November 8, 1976. A maximum of approximately 150 kings were present in the holding pond at one time, that being in late September. At the same time approximately 210 adult coho were present in the holding pond.

Holding both species together in the same holding pond required much sorting and re-seining of the green coho while attempting to collect ripe kings for egg takes. On October 14, logistics were extreme with sorting, holding and spawning of both species occurring at the same time.

Prior to 1976, Saprolegnia fungus had never been a problem among adult coho held at the facility. In 1976, approximately 11% of the adult coho returning to the facility were lost due to fungus. This may have been due to ripening of king salmon in the holding pond for four months prior to the arrival of coho. Most kings in the process of ripening developed some Saprolegnia, even though they were treated periodically with Malachite Green. It is believed that the holding pond was saturated with Saprolegnia spores which promptly infected bruised adult coho as they entered the holding pond. Saprolegnia ceased to be a problem after the first fall flood, which apparently flushed the system. The excessive handling of fish, the species interactions, and the danger of infection must be considered when proposing to maintain brood stocks of two or more anadromous species in a single holding pond.

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